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ABSTRACT

This teacher's guide presents teaching suggestions and presentation materials about the world's oceans and the important role humans play in maintaining the life and health of the oceans. The lesson is divided into five parts and can be taught in one class period or divided into segments. Student handouts include: (1) "Facts about Oceans and Coasts"; (2) "World Fishery Resources"; and (3) "U.S. Fleet Trawling Coastal Water without Fish." Transparency masters offer "Main Tanker Routes and Major Oil Spills" and "Areas of Major Coastal Pollution." Enrichment activities are suggested. (EH)

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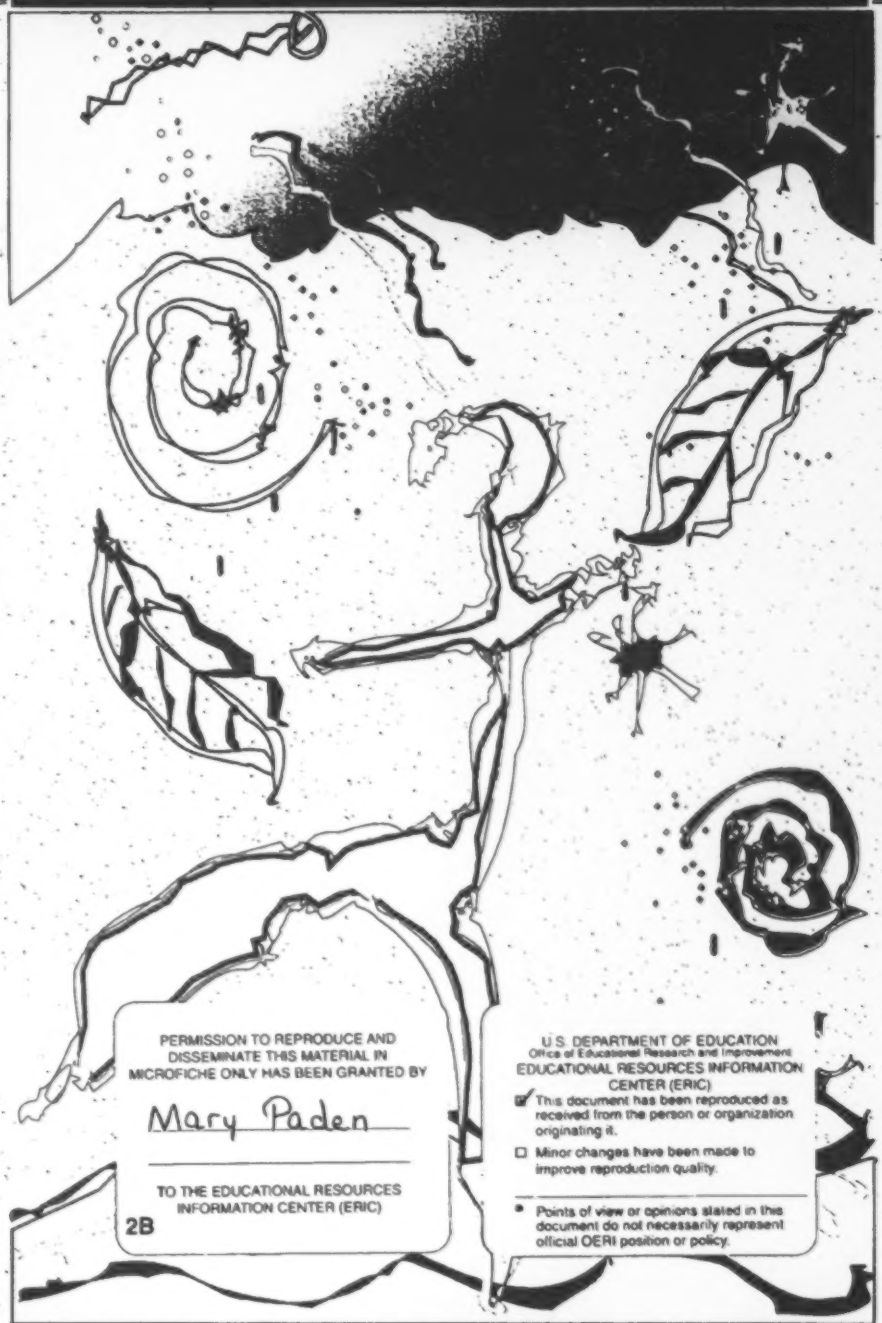
TEACHER'S GUIDE

To World Resources

Oceans and Coasts



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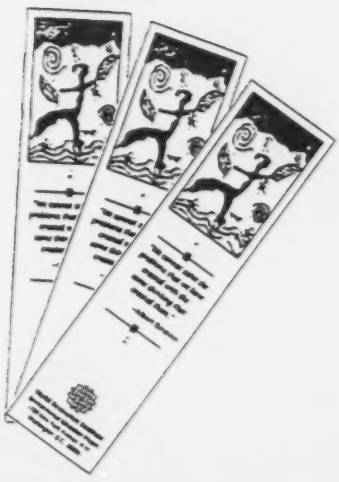

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Teacher's Guide

to

World Resources:

Oceans and Coasts

Comprehensive Coursework on the
Global Environment

World Resources Institute
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Through its policy studies, WRI aims to generate accurate information about global resources and environmental conditions, analyze emerging issues, and develop creative yet workable policy responses. In seeking to deepen public understanding, it publishes a variety of books, reports, and papers; undertakes briefings, seminars, and conferences; and offers material for use in educational settings and in the news media.

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Using World Resources Teacher's Guide Units

World Resources *Teacher's Guide* Units are designed for use at the secondary school level (although we have reports of successful use at the middle school and college levels). They weave together lessons about both environment and development, both globally and locally. They draw on skills and knowledge from the physical and biological sciences, social studies, history, economics, civics, and global studies.

Information and analysis used in the Units are drawn from World Resources Institute (WRI) publications and databases. All units are written by curricula writers and reviewed by educators as well as by technical experts. The Units are updated and revised periodically based on feedback from classroom teachers who have used the materials.

Our intent is to provide easy-to-use, inexpensive classroom materials that contain the most recent and authoritative information on the global environment because we believe it is crucial that the next generation of leaders and citizens understand the issues described here.

The complete set of *Teacher's Guide* Units includes the following topics:

- Biodiversity
- Car Trouble
- Citizen Action
- Energy, Atmosphere, and Climate
- Natural Resource Economics
- Oceans and Coasts
- Population, Poverty, and Land Degradation
- Sustainable Development
- Two Giants: China and India
- Watershed Pollution
- Women, Equity, and Sustainable Development

These units have been revised and updated with the most recent data available as of spring 1994.

Inside Each Unit

Each *Teacher's Guide* Unit should contain enough teaching suggestions and presentation materials to teach one to several classes on the topic without securing additional resources. On the other hand, each unit is designed to point teachers and students to additional resources and to offer suggestions for expanded coursework. Specifically, each unit contains objectives, a lesson plan, student handouts, overhead transparency masters, student enrichment activities, suggestions for further reading, and suggested audiovisual resources.

Using the Units for Environmental Studies

The *Teacher's Guide* Units provide a comprehensive, consistent yet highly flexible set of materials for environmental studies courses. They can be used in conjunction with an environmental science textbook to give students an understanding of basic environmental systems and cycles. Or they can be used in a social studies context to examine some of the tough problems and choices we face as a society.

Educators who want to go beyond the *Teacher's Guide* Units can read related WRI publications, which provide the basic data, source materials, and analysis for the Units. These publications are listed at the beginning of each unit. A free catalog can be obtained by calling 1-800-822-0504.

Integrating Teacher's Guide Units into the Curriculum

Secondary school teachers frequently mention the difficulty of integrating environmental issues into a tightly packed curriculum. As much as they would like to teach about the environment, they must devote class time to required subjects.

To help them place these issues in their curricula, we have coded each lesson plan and each student enrichment activity to the draft national performance assessment standards for science, math, history, civics, and geography. These standards are being developed as part of the national Goals 2000 program in the U.S. Department of Education. The standards themselves are being developed, discussed, and revised by educational organizations in nine academic disciplines. They are expected to be approved at the national level, then offered to states to incorporate into their own academic assessment plans. Although this process will take several years, we have compiled lists of assessment standards for grades 9 through 12 from drafts available in spring 1994 to offer some guidance to teachers.

A complete list of the draft standards for Grades 9 through 12 appears in Appendix B, which should be mailed to you with your order. Appendix A provides a bibliography and list of related organizations.

Integrating Global Environmental Education into High School Curricula

In an effort to link lessons about global environment and development issues to required school curricula, we have identified which pages of the lesson plan and which student enrichment activities in this *Teacher's Guide* Unit relate to the draft national performance standards developed recently for civics, geography, history, math, and science in grades 9 through 12.

These voluntary national standards are part of the Goals 2000 program mandated by the Goals 2000: Educate America Act of 1994 under the direction of the U.S. Department of Education. Among other things, Goals 2000 will establish a set of goals or performance standards for grades 4, 8, and 12 in the subjects listed above plus English, the arts, and foreign languages. These goals will be available to the states for incorporation into their own sets of educational performance standards. Each set of draft standards was developed by a professional education organization and has been presented at numerous educational conferences for review and comment. The draft standards used here are those available as of spring 1994.

Although many countries have national performance standards, the United States (and Canada) have treasured a decentralized educational system that sets education goals at the district or state level. Goals 2000 is the first attempt to identify a set of general education objectives that all students in the country are expected to achieve. As might be expected, there is some controversy over whether there should be national education goals—even voluntary ones—and if so, what they should be.

Regardless of the final outcome, we feel the draft goals do reflect some consensus among educators about what material should be covered at various grade levels, and as such, offer some guidance for integrating environmental education into the curricula.

Only those goals relevant to this unit are listed here. A complete list of goals appears in the 1994 *Teacher's Guide to World Resources*. Copies of reports outlining the goals for each subject area can be obtained from the education organizations listed at the top of each set of goals on this page. Information about the Goals 2000 program is available at 1-800-USA-LEARN.

Goals 2000: Draft National Performance Standards

Civics and Government*

(Draft National Standards, October 1993, Center for Civic Education, 5146 Douglas Fir Road, Calabasas, CA 91302-1467)

	Lesson Plan	Enrichment Activity
IV. What is the Relationship of American Politics and Government to World Affairs?		
1. How is the world organized politically?		2
V. What are the Roles of the Citizen in the American Political system?		
4. How can citizens participate in public life?	6	

Geography*

(Draft National Standards, October 1993, National Council of Geographic Education, Geography Standards Project, 1600 M Street, NW, Washington, DC 20036)

	Lesson Plan	Enrichment Activity
I. Seeing the World in Spatial Terms		
1. Knows and understands how to use maps, globes, and other graphic tools and technologies to acquire, process, and report information from a spatial perspective.		1, 7
2. Uses mental maps of Earth to put people, places, and environments in their spatial context.		1
II. Elements: Places and Regions		
4. Knows and understands the physical and human characteristics of place.		7
IV. Human Systems		
11. Knows and understands patterns and networks of economic interdependence on Earth's surface.	2, 3	
12. Knows and understands the processes, patterns, and functions of human settlement.	3	1, 7

Note: Only the education goals relevant to this unit are listed.

Geography—*continued*

	Lesson Plan	Enrichment Activity
V. Environment and Society		
14. Knows how Earth's dynamic physical and human systems are connected and interact.		1, 7
15. Knows the consequences of the interaction between dynamic human and physical systems.		1, 7
16. Knows changes in the meaning, distribution, and importance of resources.	5-6	
VI. Applying Geography		
18. Knows and understands how to apply geography to interpret the present and plan for the future.		1, 7

Mathematics*

(Draft National Standards, March 1989, The National Council of Teachers of Mathematics, Order Processing, 1906 Association Drive, Reston, VA 22091)

	Lesson Plan	Enrichment Activity
I. Mathematics as Problem Solving		
1. Use, with increasing confidence, problem-solving approaches to investigate and understand mathematical content.		3
4. Apply the process of mathematical modeling to real-world problem situations.		3
VI. Functions		
2. Represent and analyze relationships using tables, verbal rules, equations, and graphs.	4	
X. Statistics		
1. Construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations.	4	3
XI. Probability		
2. Use simulations to estimate probabilities.		3

Science*

(Draft National Standards, February 1994, National Academy of Sciences, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418)

	Lesson Plan	Enrichment Activity
I. Science As Inquiry		
1. Identify questions and concepts that guide scientific investigation.		3
II. Physical Sciences		
2. Chemical Interactions		6
III. Life Science		
1. Biodiversity		5
4. Ecosystems and Human Ecology	2, 5	3, 4, 6-8
7. Maintenance of a Dynamic Equilibrium	5, 6	3
V. Unifying Concepts And Processes Of Science		
2. Conservation	5	2-5, 7, 8
VI. Science and Technology		
1. Problem Identification	5	2, 3, 8
2. Solution Design-Cost, Risk-Benefit Analysis		6, 8
3. Solution Implementation		2
4. Solution Evaluation		3, 6
VII. Science and Societal Challenges		
2. Natural Resources	2-6	1-8
3. Environmental Degradation	2-6	1-8
4. Natural and Human-Induced Hazards	2-6	1-8
5. Community Health		8
6. Global Change		1
VIII. History/Nature of Science		
1. Scientific Inquiry		6, 8

Oceans and Coasts

Years ago, beachcombers dreamed of finding a message in a bottle that washed up on shore, but such a thing was rare. Today's beachcombers are almost sure to find a bottle, either left behind by a picnicker or carried there from thousands of miles away by ocean currents. The bottle itself is the message because it's made of plastic. The bottle is a reminder that people play an important role in the life and health of the world's oceans. Most of the wastes and contaminants produced by human activities end up in the sea.

This lesson explores the state of the world's oceans today and the important role that humans play in maintaining the life and health of the oceans. It begins by examining oil spills, a type of pollution that receives enormous publicity and threatens marine life along the coasts. Then, coastal areas are compared with the open ocean, noting specific types of pollution. An activity on world fishery resources explores the pressures of pollution, destruction of nursery grounds, and overfishing. At the end of the lesson, students are encouraged to identify means of dealing with ocean pollution.

Objectives

By the time they finish this lesson, students should be able to:

- Describe some of the ways the oceans are vital to life on Earth.
- Explain how some human activities influence the ocean.
- Compare and contrast the state of the open ocean with the coastal areas.
- List types of marine pollution and describe their effects.
- Describe the development of global fishery resources and explain why these resources are limited.
- Identify steps at the international, national, and local levels that could help control marine pollution.

Teaching Strategies

This lesson is divided into five parts. It can be taught in one class period or divided into segments that may be used in several classes if you wish to integrate the segments into your own lesson plans or do additional activities.

The lesson includes the following materials that may be duplicated:

Student Handouts

1 Facts About Oceans and Coasts
2 World Fishery Resources
3 U.S. Fishing Fleet Trawling Coastal Water Without Fish

Overhead Transparency Masters

1 Main Tanker Routes and Major Oil Spills
2 Areas of Major Coastal Pollution

For a complete picture of global water resources, we suggest you also use the World Resources Institute Teacher's Guide chapter, *Watershed Pollution*, available from WRI. For further data and analysis on oceans and ocean fisheries, see *World Resources 1994-95*, also available from WRI. The primary sources for most of the material on ocean pollution are a United Nations report, *The State of the Marine Environment* (United Nations Environment Programme, Nairobi, Kenya, 1992) and statistical data from the Fisheries Division of the Food and Agriculture Organization of the United Nations.

Beginning the Lesson

Ask students if they have ever seen any evidence of marine pollution, either in their own experience or in the news media. Ask them to describe what they saw (e.g., plastics, oil, warning signs about the dangers of swimming or eating fish).

Discuss this question: *Why are the world's oceans important?* (Oceans are vital to support life on Earth. They modify climates, are a reservoir of dissolved gases such as carbon dioxide, and provide habitat and food. The oceans provide millions of tons of food for both animals and people as well as a livelihood for millions of people. The oceans are a highway, linking the countries of the world, a highway traveled by ships laden with raw materials and manufactured goods.)

Introducing One Source of Marine Pollution

Show a transparency made from **Overhead Transparency Master 1, "Main Tanker Routes and Major Oil Spills,"** and discuss it using the following questions:

Where have the major oil spills occurred? Along coastal areas since the routes tend to hug the coasts.

Why are coastal spills a problem? Because people live/work/play along the coasts, and because the coastal waters are where most ocean life exists. Breeding and nursery areas for fish and other sea creatures lie along the coasts.

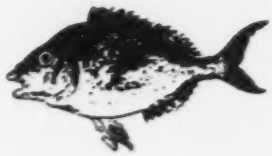
Are all oil spills equally damaging? No, the amount of environmental damage depends on factors such as the type of petroleum, the time of year, the weather conditions—these affect how far the spill will spread—and the location—coastal areas rich in marine life are most sensitive to pollution.

Are tanker accidents such as the Exxon Valdez the main source of oil pollution? No. The number and amount of oil spills worldwide actually declined between 1974 and 1986. Also, tanker operations release more oil than tanker accidents. Municipal and industrial waste discharge and runoff also are significant sources of petroleum pollution (36.3 percent).

Defining the Problem of Marine Pollution

Distribute copies of **Handout 1, "Facts About Oceans and Coasts."** After students have had a chance to read it, ask, *Is petroleum pollution the main type of marine pollution?*

Discuss the various types of pollution. The major marine contaminants are, in order of importance: 1) nutrients from urban sewage and rural runoff; 2) microbial contaminations from sewage; 3) plastics from land and sea disposal; 4) synthetic organic compounds such as pesticides and industrial chemicals; and 5) oil from routine transport and spills.



Emphasize that, while tanker accidents are dramatic and well publicized, these happen only occasionally and their effects are local. Other contaminants, largely invisible and unpublicized, enter the oceans daily all around the globe.

Help students to compare and contrast the state of the open ocean and the coasts.

The Open Ocean

Today, the open ocean is still relatively clean because most pollution sources are on land. Most contaminants are waterborne in rivers, drainage pipes, or storm runoff and settle to the bottom as water movement slows. In the open ocean, there is occasional deep-water dumping, but most pollution comes from shipping activities or from atmospheric pollution. However, plastic litter is found in all the world's oceans. Nonbiodegradable and buoyant plastic bottles, bags, sheeting, pellets—even six-pack-container rings and balloons—degrade the aesthetic qualities of beaches and coastal waters, and kill fish, turtles, birds, and marine mammals.

Coastal Areas

Most of the world's coastal areas are polluted, especially near cities. Historically, people have lived near the coasts for food, transportation, and aesthetics. Today, more and more people are settling on the ocean shores, and by the year 2030, an estimated 75 percent of the world's population will live on the coasts or along rivers that flow into the sea. Buildings and roads are replacing sand dunes, mangrove swamps, and wetlands. As the land is cleared, silt washes into the ocean. Industrial and agricultural waste and sewage drain into the coastal waters, loading

them with disease-causing organisms, toxic materials, and excess nutrients that lead to excessive plant growth and, eventually, oxygen-depleted water. Offshore drilling for oil and gas adds contaminants as does the transportation of oil. Most tanker accidents have occurred in coastal areas. **Overhead Transparency Master 2, "Areas of Major Coastal Pollution,"** shows that most of the polluted areas are near large population centers.

Examining Global Fishery Resources

Ocean fishing, a major source of food and jobs, is threatened by overfishing as well as by pollution. The world's fish catch in 1988 was five times what it was in 1950 because of heavy fishing by rapidly expanding world fishing fleets and improved technology. Now, fish populations in some regions have begun to decline or even disappear. In several cases, this decline is because the fish are being caught faster than they can reproduce.

Distribute copies of **Handout 2, "World Fishery Resources."** This exercise asks students to analyze information presented in a graph, to suggest an explanation for trends. After students have completed the exercise, discuss the answers:

Figure 1

Items 1 and 3 are supported by evidence in the graph.

- The total fish catch in 1970 was about 70 million metric tons.
- By 1989, the total fish catch was about 80 million metric tons—50 percent higher than the 1970 catch.
- Note the small hump in the trend line in the 1970s. During the early 1970s, El Niño, a climatological event that mutes the cold-water upwelling off the coast of Peru, caused a sharp decrease in catch of Peruvian anchovies. At the same time, the anchovies were being heavily fished. As a result, the fishery collapsed. This is a good example of the interrelationships among global systems. Changes in the atmosphere affect the oceans. Changes in the ocean, along with pressure by people, affect the fish. Changes in the fish supply affect people.

Figure 2

Item 7 is supported by information in the graph.

- Until 1983, the more days fishermen fished, the more fish they caught. After 1983, despite sustained fishing efforts, they caught fewer fish.
- The experience of the Georges Bank Fishery was a classic case of overharvesting and subsequent resource depletion.

Figure 3

Items 8 and 9 are supported by data in the graph. Item 10 is an unlikely hypotheses. Encourage students to form their own hypotheses based on the data presented and discuss what further data they would need to support their hypotheses.

Questions

Question 1 asks students to suggest explanations for the trends shown in Figures 1, 2 and 3. Reasons for the dramatic increase in fish catch include improved fishing technology, expanded fishing fleets, and increased demand for fish to feed both increasing coastal populations and livestock, which stimulates both fishing and aquaculture.

Question 2 offers an opportunity to relate fishing resources to the problems of marine pollution and overfishing. Emphasize the following points:

- Eutrophication, chemical pollution, and the destruction of nursery grounds will create increasing stress on fishing resources.
- There is now evidence that the world's fishery resources are limited; formerly these resources were thought to be unlimited. The Food and Agriculture Organization of the United Nations (FAO) estimates the potential yield for marine fish is 62–87 million metric tons annually. *Yield* means the amount of fish that the oceans can continue to produce. If too many fish are caught, not enough fish are left to reproduce and the population declines. Figure 1 shows that the 1990 total fish catch of 75 million metric tons is within the range of the potential yield. Most local fisheries are now moderately to heavily exploited. The estimated sustainable yield is now exceeded in 4 of 16 major fisheries (the Pacific Northwest, the Mediterranean and Black Sea, the Eastern Indian Ocean, and the Southeast Pacific). Ten out of 14 fisheries along the U.S. coast from Maine to Texas are overexploited. Globally, the annual marine catch increased by 30 percent over the last 10 years. Two nations, Japan and the former Soviet Union, together caught one quarter of the world's total. Since the breakup of the former Soviet Union, the new republics have drastically decreased their fishing efforts, which is reflected in the lower world catch.

Handout 3, "U.S. Fishing Fleet Trawling Coastal Waters Without Fish," an article that appeared on page 1 of the *New York Times* on March 7, 1994, describes how a combination of overfishing and pollution has devastated the U.S. fishery. After students have speculated on possible reasons for the fishery decline on Georges Bank, pass out and discuss the reasons pointed out in this article. Key reasons are:

1. Overfishing, caused by a) new, more efficient fishing gear and b) a lack of management controls to restrict the amount of fish caught.

2. A "Tragedy of the Commons" situation. As Garrett Hardin first described in his classic book about natural resource management, *The Tragedy of the Commons*, when a natural resource (such as fish) belong to everyone in common (or to no one in particular), there is an economic incentive for everyone to take as much as they can get, without regard to conserving the resource.

3. Dams and pollution have contributed to the decline in the number of fish.

4. Note that the article points out that although both the U.S. coastal fishery and the world fisheries are in a serious decline, consumers may not notice because more fish is being raised in fish farms. As of 1989, the amount of fish produced in fish farms represented only 5 percent of the total marine fish production and 12 percent of combined marine and freshwater production. Most fishery experts agree that aquaculture and mariculture, although important, could not replace the amount of fish taken in the world ocean fishery.

Georges Bank is a classic example of a population crash caused by too much pressure (fishing, pollution) on a resource. However, the situation was more complex than a simple population crash because there was also a change in the species of fish that made up the Georges Bank ecosystem. As the more popular codfish were caught, the less desirable shark-like dogfish population expanded. (Dogfish are sold as a table fish in Europe but not in the United States.) By 1991, not only was the total catch smaller, but it was also made up largely of different species. This shift in species composition will make restoration of the original ecosystem very difficult, even if fishing were stopped.

Concluding the Lesson

Ocean pollution has many different sources since most of the wastes and contaminants produced by human activities end up in the ocean. Help students to brainstorm ways in which their activities and those of people in their community affect the oceans. If they live near the coast, students may see clear connections (i.e. leaving litter on the beach and boating). If they live inland, it may be harder to see the connection. It may be helpful to point out that the watershed of the Mississippi River covers 40 percent of the lower 48 states. Remind students that polluted rivers and streams end up in the ocean. Thus, motor oil poured down a storm sewer or fertilizer applied to a lawn is likely to contribute to marine pollution. Much trash along the beach was once litter discarded on city streets.

Write the following question on the chalkboard.

What are some ways to deal with ocean pollution? Have students brainstorm actions that they, as individuals or a group, can take. For example, they can:

- Review their lifestyle and habits to identify impact on the environment and changes they could make (for example, cutting up plastic six-pack holders before disposing of them).
- Inform themselves about sources of pollution in their community and region that contribute to marine pollution and any attempts to control these sources, including proposed legislation.
- Join community or national groups working to protect the environment—for example, by preserving wetlands, bays, coasts, or marine mammal species.

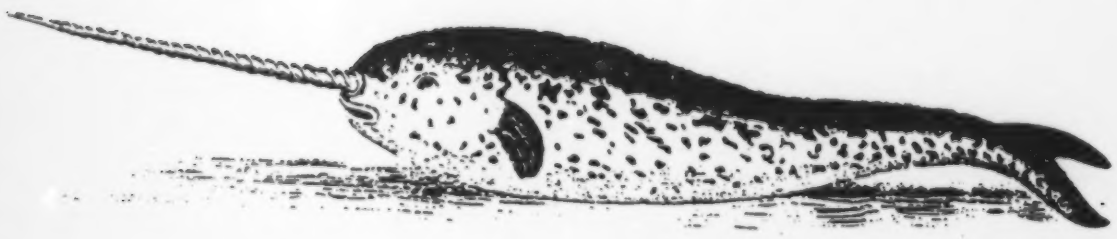
You might want to have each student write a brief personal statement about marine pollution, describing the problems and what the student plans to do about them.

Strong action at the national level was recommended by the United Nations Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) in its 1992 report *The State of the Marine Environment*. Help students to list different types of national action such as enacting clean water standards, reducing the use of pesticides, funding research to protect marine species (such as the Turtle Excluder Device, designed to prevent sea turtles from being caught in shrimp nets). One success story: since the United States and Sweden banned DDT, the DDT concentration in fish and shellfish has declined.

International cooperation is also vital if ocean pollution is not to continue to increase. Some international agreements have been worked out; for example, dumping rules have been established. These agreements are limited, but form a broad foundation for controlling marine pollution.

Suggestions for Further Reading

- *Annual Report of the Marine Mammal Commission,* (Marine Mammal Commission, Washington, D.C., 1993).
- *Cleaning North America's Beaches: 1992 Beach Cleanup Results,* (Center for Marine Conservation, Washington, D.C., 1992).
- *Ocean Yearbooks,* Elisabeth Mann Borgese and Norton Ginsburg, eds. (University of Chicago Press, published annually).
- *Oceanus: The International Magazine of Marine Science,* Woods Hole Oceanographic Institution, Woods Hole, MA.
- *The Siren,* United Nations Environment Programme, Nairobi, Kenya (free quarterly newsletter on UNEPs Regional Seas Programs).
- William W. Warner, *Distant Water,* (Atlantic Monthly Press, Boston, MA, 1983).
- *Baybook: A Guide to Reducing Water Pollution at Home* (Alliance for the Chesapeake Bay, Baltimore, MD, 1993).
- Rachel Carson, *The Edge of Sea* (Houghton Mifflin, Boston, MA, 1955).
- Rachel Carson, *Under the Sea Wind* (Houghton Mifflin, Boston, MA, 1955).



1 Map Ocean Pollution

Give each student a world map. Ask students, working either individually or in small groups, to color in those areas of the oceans they think are most polluted. Compare maps and ask students to comment on their maps. Then show a transparency made from **Overhead Transparency Master 3.2, "Areas of Major Coastal Pollution,"** or give each student a copy of this map. Identify the areas of major pollution and the probable sources of pollution.

Skills emphasis:* *Geo I 1–2, IV 12, V 14–15, VI 18; Science VII 2–4, VII 6*

Suggested for use in: *Geography, Social Studies, Environmental Issues, Earth Science.*

2 Compare Whales and Sea Turtles

The numbers of whales and sea turtles are declining. What are the chief threats to these creatures? To what extent are they now being protected by conservation groups and by the actions of individual countries. Why is international action necessary to protect these creatures?

Skills emphasis: *Civics IV 1; Science V 2, VI 1, VI 3, VII 2–4*

Suggested for use in: *Biology, Ecology, Environmental Science, Environmental Issues, Social Studies.*

3 Manage a Fishing Company

Fish Bank, Ltd. is a computer-assisted simulation that teaches principles for the sustainable management of renewable resources—in this case, fish. The game is suitable for use by groups of any size between 8 and 40 players and requires about three hours, with minimal setup time. Players are divided into teams, each of which operates its own fishing company in a common ocean. The interaction in the game provides a framework for understanding the behavior of fisheries and other renewable resources. The game also provides a metaphor for discussing solutions to the problem of resource depletion. Dennis L. Meadows and Thomas S. Fiddaman of the University of New Hampshire, developers of the simulation, state that because players "have directly experienced the collapse of a resource, entirely due to their own behavior, the players feel a greater sense of responsibility for finding solutions to the real-world problems." Fish Banks, Ltd. is available for Apple Macintosh or IBM computers for US$100. Contact Prof. Dennis Meadows, Director, Institute for Policy and Social Science Research, Hood House, University of New Hampshire, Durham, NH 03824.

Skills emphasis: *Math I 1, I 4, X 1, XI 2; Science I 1, III 4, III 7, V 2, VI 1, VI 4, VII 2–4*

Suggested for use in: *Environmental Issues, Ecology, Biology, Social Studies, Geography*

4 Publicize Plastic Pollution

Items made of nonbiodegradable plastic are an important source of marine pollution. Using plastic six-pack holders, fishing line, containers, and other items, students could create a display that shows how these items get into the oceans and how they damage wildlife and degrade beaches. The display might also include information about recycling plastic items and ways to cut down on the use of plastic, such as using recyclable or reusable glass containers. (A helpful resource for this activity is the following article: Weiskopf, Michael. "Plastic Reaps a Grim Harvest in the Oceans of the World." *Smithsonian* (March 1988), pp. 58-66.) Also see *Citizen's Guide to Marine Debris*, Center for Marine Conservation, Washington, D.C.

Skills emphasis: *Science III 4, V 2, VII 2–4*

Suggested for use in: *Biology, Ecology, Regional Studies, Environmental Issues, Art*

5 Examine Aquaculture

"Fish farming" is seen as one way to produce food for the world's increasing population. What fish products (for example, catfish) carried by local grocery stores and fish markets are the result of aquaculture? How much fish and what kinds of fish and shellfish are produced through aquaculture in the United States? What are the environmental consequences of aquaculture?

Skills emphasis: *Science III 1, V 2, VII 2–4*

Suggested for use in: *Environmental Issues, Health, Social Studies*

See chart of Draft National Performance Standards at beginning of this unit.

6 Investigate Bioremediation

Can microbes solve one kind of pollution problem? In June 1990, oil-eating microbes were successfully used to gobble up oil that had leaked into the Gulf of Mexico when the Norwegian tanker *Mega Borg* exploded and burned. Have students gather facts on this and any other similar cases. What bacteria are used? How do they function? In what types of oil spills have they been used? Can major damage from oil spills be prevented by using oil-eating microbes?

Skills emphasis: *Science II 2, III 4, VI 2, VI 4, VII 2–4, VIII 1*

Suggested for use in: *Biology, Chemistry, Ecology, Environmental Issues.*

7 Follow a River

To help illustrate the fact that human activities far inland can cause marine pollution, have students, either individually or in small groups, trace the path of a local river to the ocean—for example, the Huron River to Lake Erie, over Niagara Falls to Lake Ontario, and out the St. Lawrence River to the Atlantic Ocean. Considering the land uses— industrial, urban, agricultural, forest—around the river, what pollutants is it likely to pick up on its way to the sea? Students might prepare a poster with a large map and explanatory notes to show the path and final destination of the plastic bottle or motor oil that enters the storm drains in your town.

Skills emphasis: *Geo I 1, II 4, IV 12, V 14–15, VI 18; Science III 4, V 2, VII 2–4*

Suggested for use in: *Geography, Social Studies, Regional Studies*

8 Examine Land Use Issues

Have each student choose one type of ocean pollution (sewage, fertilizers, pesticides, heavy metals, sediments) and investigate the relationship between this pollution and human activities on land. How does the use of fertilizers affect the ocean, for example? To lessen ocean pollution, what changes would have to be made in land use? Would it be possible to make these changes? Research could be represented in a short oral or written report.

Skills emphasis: *Science III 4, V 2, VI 1–2, VII 2–5, VIII 1*

Suggested for use in: *Social Studies, Environmental Issues, Biology, Ecology*

Audiovisual Resources

- *The Living Ocean,* (1988), 25 min. National Geographic Films.
- *Estuary,* VHS and 16mm film, National Film Board of Canada, 12 min., Bullfrog Films. *A close-up look at the biologically important wetlands where the freshwater of a river meets the saltwater of the ocean.*
- *The Ocean Planet: The Death of the Mississippi,* VHS, 23 min., Films for the Humanities and Sciences. *The decline of that once mighty river.*
- *The Ocean Sink,* VHS, 29 min., Films for the Humanities and Sciences. *What happens when the sea is used as a dumping ground?*
- *Troubled Waters: Plastic in the Marine Environment,* VHS, 29 min., Bullfrog Films. *This video presents a picture of the many ways that plastics find their way into the oceans and the danger this plastic poses to marine life.*
- *Sea Turtles: Ancient Nomads,* (1988), VHS, 60 min., TBS Inc. Library Tape Sales. *The graceful sea turtle faces extinction without immediate aid.*
- *Where the Bay Becomes the Sea,* VHS and 16mm film, 30 min., National Film Board of Canada, Bullfrog Films. *Documents the wondrously fertile coastal ecosystem where the Bay of Fundy meets the Atlantic Ocean.*

Facts About Oceans and Coasts

The oceans cover 71 percent of the Earth and are home to over 80 percent of its living organisms. Oceans interact with the atmosphere, the sea floor, and the land to maintain conditions for life on Earth. Most of ocean life is found along the coasts. More than 99 percent of the global catch of marine fish is caught within 199 miles (320 kilometers) of shore. Half of the world's population lives in coastal areas.

State of the Oceans

- Most of the wastes and contaminants produced by human activities end up in the oceans. Some are directly drained or dumped, either purposely or accidentally, in the case of oil spills. Rivers carry runoff from city streets, sewage, industrial wastes, pesticides and fertilizers from farms, and silt from land-clearing and construction projects. Some pollutants first enter the atmosphere and later settle in the ocean.
- Chemical contamination and litter exist from the poles to the tropics, from beaches to ocean depths.
- The open ocean is relatively clean because most pollutants come from land and remain in water near coastal areas.

State of the Coasts

- Most of the world's coastal areas are polluted.
- Pollution and development are changing coastal habitats. Feeding and nursery areas are being destroyed, reducing fish and wildlife populations.
- Along some coasts, runoff enriches the water with too many nutrients, leading to oxygen-depleted water and fish kills.
- The two most widespread and serious sources of coastal pollution are sewage disposal and sedimentation from land-clearing and erosion.

Types of Pollution

- SEWAGE: Contaminates the water with organisms that cause diseases such as hepatitis, cholera, and typhoid fever. Humans can become infected by eating contaminated shellfish and by swimming. Most of the world's sewage is not treated.
- MARINE LITTER: Human activities on land are a major source of plastic debris. Plastic items such as six-pack-container rings wash down rivers and enter the ocean. Found even in remote Antarctica, nonbiodegradable plastics harm porpoises, seals, turtles, birds, fish, and other marine life, and degrade beaches. Equipment from the fishing industry (nets, lines, buoys, etc.) that has been lost or discarded at sea is another source of litter.
- PETROLEUM: Kills birds, fish, and animals, causes long-lasting problems for marine organisms, and fouls beaches. Most oil spills occur in coastal waters where oil is being drilled or transported. Petroleum also enters the sea in the form of municipal and industrial wastes.
- SYNTHETIC ORGANIC CHEMICALS: Pesticides and industrial chemicals inhibit photosynthesis and movement in plankton and cause tumors, birth defects, and other damage in vulnerable organisms. These substances are widely distributed in the oceans, and some accumulate in the food chain. In areas of heavy pollution, fish and shellfish can become unfit for human consumption.

Facts About Oceans and Coasts *(continued)*

- TOXIC METALS: These are a minor hazard because they occur in low concentrations, aside from a few isolated hot spots.
- RADIOACTIVE SUBSTANCES: Natural radioactive substances are present everywhere along with a very small amount caused by fallout from nuclear weapons testing.

Trends

- Marine pollution is increasing. The marine environment will continue to deteriorate significantly unless strong national and international action is taken.
- If global warming continues, it is likely to warm sea water, which would cause the water to expand. This would raise sea levels and flood coastal areas. Weather patterns over the oceans could also change, bringing more frequent storms. Locations of currents and fishery areas could be altered as well.

Recommendations

In 1990, a United Nations study group, the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) recommended:

- National and international action to protect the coastal zone.
- Changes in sewage disposal techniques and agricultural practices to control eutrophication.
- Upgrading and enforcing public health standards for sewage pollution of beaches and shallow waters.
- Production and use of packaging materials that are less harmful to the environment than plastics.
- Research into the effects of chemical contaminants on organisms and the effects of silt as a marine pollutant.

Source: Group of Experts on the Scientific Aspects of Marine Pollution, *The State of the Marine Environment* (United Nations Environment Programme, Nairobi, Kenya, 1992).

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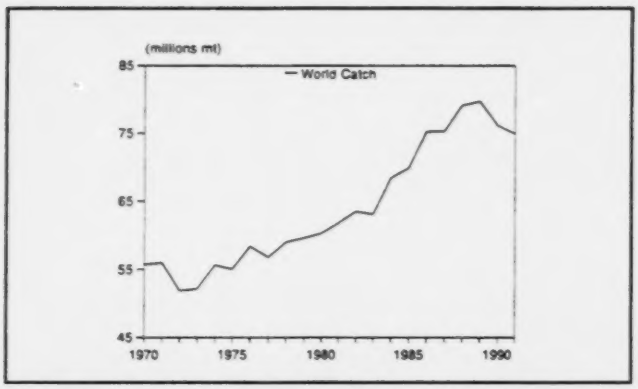
World Fishery Resources

Figure 1 World Marine Fish Catch, 1950–91



Source: Food and Agriculture Organization of the United Nations, 1991.

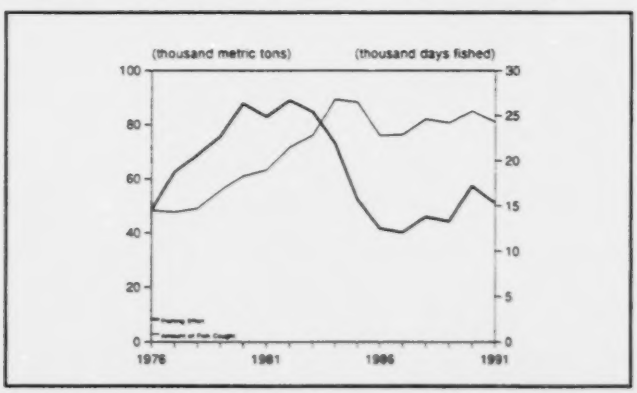
Figure 1 Questions

___ 1. About 55 million metric tons of fish were caught in 1970.

___ 2. By 1989, the total fish catch was 50 more than the total fish catch in 1970.

___ 3. By 1991, the total fish catch had declined to about ___ metric tons.

Figure 2 Total Fish Catch vs Level of Fishing



Source: National Marine Fisheries Service, unpublished data, Northeast Fisheries Science Center, 1993.

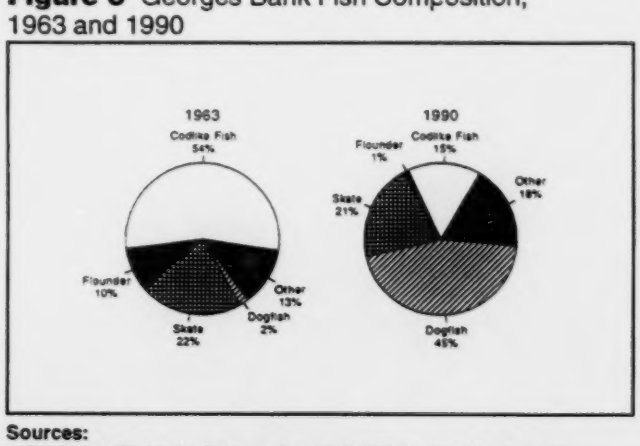
Figure 2 Questions

___ 5. The more effort (days spent fishing) that fishermen expend, the more fish they catch.

___ 6. The more effort fishermen expend, the fewer fish they catch.

___ 7. Despite expending more effort, fishermen caught fewer fish after the mid-1980s.

Figure 3 Georges Bank Fish Composition, 1963 and 1990



Sources:
1. Northeast Fisheries Science Center (NEFSC), unpublished data, Woods Hole, Massachusetts, May 1993.
2. Mark Alan Lovewell, "Georges Bank: An American Tragedy," *Vineyard Gazette* (January 8, 1993, Martha's Vineyard, Massachusetts), p. 1 and 8, Sec. B.

Figure 3 Questions

___ 8. In 1963, most of the fish sampled by researchers on Georges Bank were in the codfish family (codlike fish), a popular table fish.

___ 9. By 1990, the percent of codlike fish sampled had declined and the percent of dogfish (a small shark, eaten in Europe, but not in the United States) had increased.

___10. The change in the type of fish caught occurred because consumers now prefer eating small sharks to codfish.

21

World Fishery Resources *(continued)*

Briefly answer the following questions.

1. What might be some reasons why the total fish catch increased after 1970?

2. Is the world fish catch likely to continue increasing? What factors are likely to influence the global fish catch in the future?

3. Why do you think that on Georges Bank the amount of fish caught declined in the mid-1980s, despite the fact that fishermen put more effort into catching them?

4. Why do you think fishermen caught fewer codfish and more dogfish in 1990 than in 1963?

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U.S. Fishing Fleet Trawling Coastal Water Without Fish

By TIMOTHY EGAN
Special to The New York Times

SEATTLE, March 6 — For the volunteers who count fish returning from the sea to fresh water, this has been the loneliest year ever. The surging Pacific salmon and steelhead are gone; what the fish counters at the Puget Sound ship locks see when they stare at the glass wall separating them from the water is nothing but a reflection of their own faces.

Across the country, in Gloucester and New Bedford, Mass., the story is the same. After 350 years, the oldest American fishing area is largely barren of the great swarms of haddock, cod and flounder that sustained more than 10 generations of New Englanders and became millions of fish sticks.

The Atlantic fishermen have asked that the Government treat them like earthquake disaster victims. Last week, they honked their boat horns in Boston Harbor to draw attention to their plight. To some, it was a funeral dirge.

Echoes of a Sad Song

From Chesapeake Bay, where oystermen are fading like fog in the afternoon sun, to the Gulf of Mexico, where grouper and red snapper are mostly a memory, people who pull fish from the sea for a living are singing the same sad song.

Government officials say most of the major commercial fishing areas in this country outside Alaska are in trouble, and worldwide, 13 of the 17 principal fishing zones are depleted or in steep decline.

As for salmon in the Pacific Northwest, and three main commercial species in New England, the decline is catastrophic — threatening to wipe out not only whole industries but also cultures and communities that are fused to the cycles of tide and sea currents.

A Year Without Salmon

For the first time, there may be no ocean salmon fishing on the West Coast this year, a situation roughly akin to Georgia not producing any peaches.

Fishing communities in Massachusetts are in such bad shape that Gov. William F. Weld last week requested emergency financial aid from the Federal Government. Thousands of fishermen are in "immediate danger" of losing their homes and boats this spring, Mr. Weld said.

But aside from devotees of wild fish, consumers may not notice a shortage of fish at the supermarket. In recent years, farm fish raised in pens in Norway or South America have flooded the market, driving down the price of fish.

In some cases, the lowered prices have led fishermen to harvest more ocean fish in compensation. About 40 percent of the nation's important saltwater species have been overfished, meaning more fish have been taken than there are young fish to replace them, according to a recent report by the National Marine Fisheries Service.

Who exactly is at fault in the decline is much debated. Old-time fishermen blame factory trawlers, boats the size of football fields that using sonar and satellite communications to track huge schools of fish in remote areas. The trawler owners blame small-boat operators who do not follow the rules, fishing out of season or using illegal nets. Environmentalists blame industries that have drained wetlands and dumped toxic materials into shallow bays.

Experts seem to agree on a few points. Pollution has indeed played a role: Pacific salmon have disappeared because the freshwater streams where they spawn have been soiled or are blocked by dams. Restoring the streams in the Northwest may cost more than $2 billion.

But, the experts say, fishermen themselves are also to blame for taking more than the sea could give back in New England, the mid-Atlantic and the Gulf of Mexico. "You can boil it all down to the fact that there are far too many fishermen and not enough fish," said Dick Schaefer, the conservation director of the national fisheries service.

Technology has made fishing so sophisticated that major marine areas can be cleaned out in a short time.

And the system set up to regulate these public resources is awash with conflicts of interest. Fishing in United States waters is regulated by eight regional councils, which themselves are dominated by the fishing industry. In most cases, the councils have been unable or unwilling to set fishing limits for themselves.

Critics say it is as if the national forests were handed over to the timber industry to decide how many trees to cut every year. The fishermen who defend the present system say the councils are weighted toward their industry because they are the most knowledgeable and have a self-interest in preserving fishermen's livelihood.

As a result, most fishing areas are free-for-alls, as fishermen try to catch as many fish as possible before a rival does. Congressional leaders say the councils will probably be remade this year as legislators consider reauthorizing the nation's fundamental fishing law, the Magnuson Act.

"If I had my druthers, these councils would be run by professional managers rather than political appointees," said Wally Pereyra, a member of one of the panels, the North Pacific Fishery Man-

agement Council, which covers Alaskan waters. "But as it is, if you removed people who have a stake in the industry, you'd probably have to excuse everyone on the council."

Like many members of these councils, Mr. Pereyra has a financial stake in what he is regulating. A marine biologist, he owns a share in a factory trawler that takes pollock from the Bering Sea.

More Demand for Fish

Worldwide, fish provide more than half of all the animal protein consumed by people. As the global population has exploded, fishing has tried to keep up with the demand, growing by more than 50 percent in one generation's time.

But the oceans, which cover 70 percent of the earth's surface, may have reached the limit of what they can produce. Nine out of the worlds' 17 major fisheries are in serious decline, and four others are classified as commercially depleted, according to a report last summer by the United Nation's Food and Agriculture Office.

United States officials thought they could avoid becoming part of a global trend of overfishing when they passed the Magnuson Act in 1976. It expanded the coastal economic zone claimed by the United States from 3 miles offshore

Pollution and overfishing produce a year of tiny catches.

to 200 miles, effectively chasing away large foreign fishing fleets.

But with foreign fishermen gone, Americans began to build up their fleet, buying huge vessels and equipment with low-interest loans backed by the Government.

Too Many Boats

For several years, times were good. In the North Pacific, fishermen took in $1.5 billion a year for their Alaskan pollock. In the gulf, the number of shrimpers increased significantly, although this led to a large decline in the species of fish, like groupers and red snappers, that are accidently caught in the small-mesh shrimp nets.

And in New England, many fishermen had record years as they went after the bounty that had been claimed by boats from Russia, Germany and Spain.

But now there are too many boats and not enough fish. Representative Gerry E. Studds, the Massachusetts Democrat who heads the House Merchant Marine and Fisheries Committee, has proposed that the Government pay fishermen to get out of the business. Here in Seattle, home port for most of the North Pacific trawlers, fishermen spend as much time in bankruptcy court as they do mending nets.

"The problem of foreign overfishing has been replaced by even more serious overfishing by the American fishing industry," said Valerie Christy, a spokeswoman for the Marine Conservation Network, a coalition of major environmental groups.

With boat mortgages and equipment costs to meet, some fishermen are loath to limit their take as a way of providing for future years, although some fishermen criticize that as short-sighted.

"The ocean is a farm," said Harold Lashley, a 78-year-old retired Gloucester fisherman. "If you take away all the feed and the females, when it comes time to plant, you haven't got any seed. Leave it alone. Seed the ocean and allow the fish to grow."

To protect the fish that are left, the Government has closed a large part of Georges Bank, the continental shelf east of Cape Cod whose stocks of cod, haddock and flounder have been exhausted, and has approved a plan that by restricting fishing days will reduce the catch off New England by 50 percent over the next five to seven years.

The measures were put in place only after the council that is supposed to regulate New England fishing was sued in Federal court. Similarly, on the West Coast, several groups are threatening lawsuits to force the regional council to protect fish species. The council considered a total salmon-fishing ban two years ago but did not proceed, and the region is now seeing the lowest number of fish returning to spawn in memory.

There are several bright spots in American fishing waters, primarily in areas with heavy regulation. New England lobster fishing has remained steady. Striped bass and mackerel have

A way of life on the verge of disappearing.

made strong comebacks on the East Coast after conservation measures were put in place. In Alaska, the nation's most productive fishing waters, the salmon catch last year was a record 200 million fish.

Some experts point to Alaska salmon as an example of how to manage fish. In Alaska, fishermen are allowed to go after the catch only after state officials determine that enough fish to sustain future generations have returned to spawning grounds. And there is a limit on the number of fishermen. Most other American fisheries are wide open, with no restrictions on either fish or who catches them.

If present trends hold, not only will major American fishing areas continue to decline, but the culture lives that revolve around them may also disappear. The Magnuson Act requires fishing managers to consider preserving "a way of life" as they try to conserve fish. But putting that into policy has been difficult.

Mr. Lashley, the Gloucester fisherman, says his family has been in fishing for hundreds of years, but that will change. Mr. Lashley said his grandson, Michael Lashley, 28, "will definitely be the last fishermen in the family."

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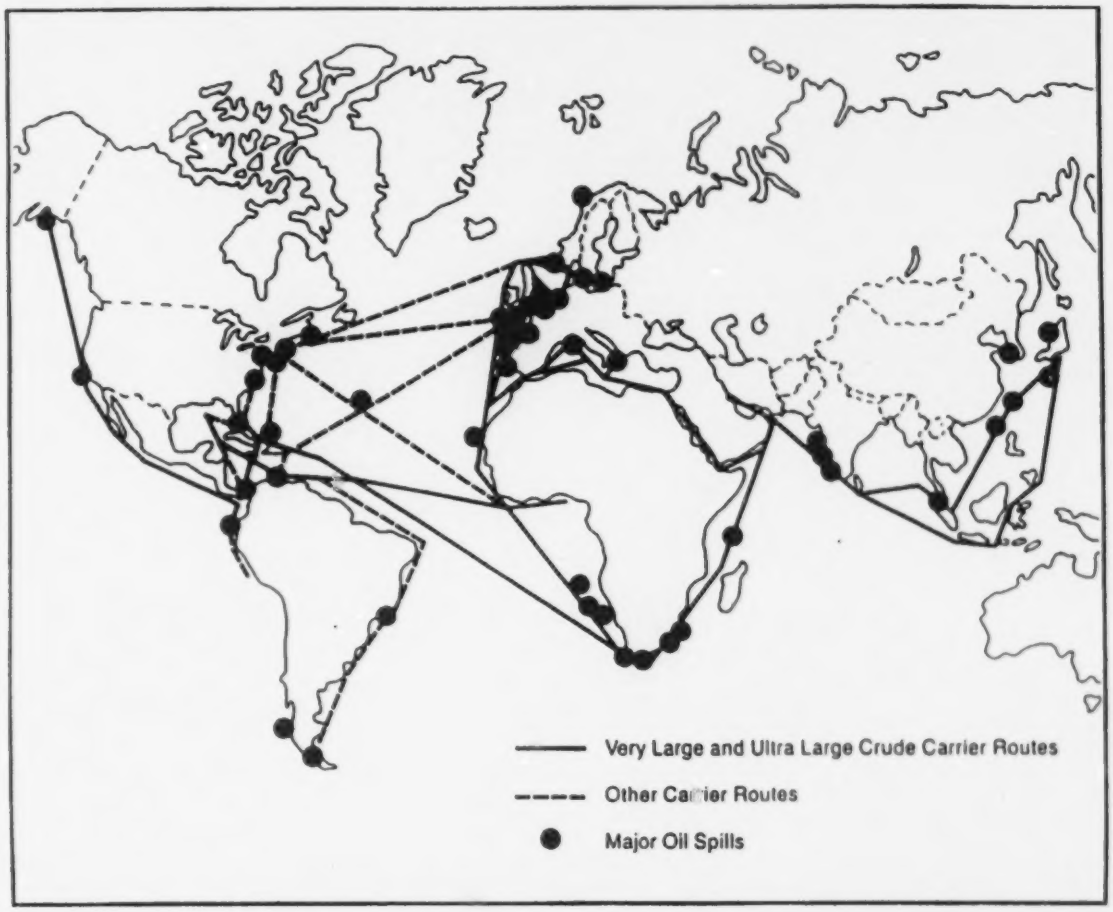
Main Tanker Routes and Major Oil Spills



Source: *Oil Companies International Marine Forum, Higher Risk Sea Areas: A Risk Analysis* (Witherby Co. Ltd., London, 1989), as cited in World Resources Institute in collaboration with the United Nations Environment Programme and the United Nations Development Programme, *World Resources 1990–91* (Oxford University Press, New York, 1990).

Areas of Major Coastal Pollution

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Source: A.D. McIntyre and James Broadus, Group of Experts on the Scientific Aspects of Marine Pollution (1990, personal communication).

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World Wildlife Fund-Canada
90 Eglinton Ave., East
Suite 504
Toronto, Ontario
MHP 227 CANADA
Phone: 416/489-8800

Teacher's Survey
Teacher's Guide Units

(Please use additional paper if necessary)

1. Which *World Resources Teacher's Guide* unit did you use?

___1. Biodiversity
___2. Car Trouble
___3. Citizen Action
___4. Energy, Atmosphere, and Climate
___5. Natural Resource Economics
___6. Oceans and Coasts
___7. Population, Poverty, and Land Degradation
___8. Sustainable Development
___9. Two Giants: China and India
___10. Watershed Pollution
___11. Women, Equity, and Sustainable Development

2. Course(s) in which you used *World Resources Teacher's Guide* units?

___History ___Geography ___Science
___Ecology ___Biology ___Chemistry
___Environmental Studies ___Environmental Science ___Other

3. Which sections of the unit did you find most useful?

___Teaching Strategies
___Student Enrichment Activities
___Student Handouts
___Overhead Transparency Masters
___Reading and AV Lists

4. How much do you think you will use the *World Resources Teacher's Guide* units in the future?

___Often ___Occasionally ___Rarely

5. Did you use the Goals 2000 draft national performance standards to select material from the units?

___Yes ___No

6. If yes to the above question, which performance standards did you teach?_____

_____

7. Were the recommended activities in the unit useful in teaching those standards?

___Yes ___No

8. What features could be added to the *Teacher's Guide* to make it more useful to you?

_____

_____

_____

9. In what setting did you use the *Teacher's Guide* units?

___Middle school
___High School
___10th grade
___11th grade
___12th grade
___Community college
___College or university
___Adult education
___Nature center
___Zoo
___Museum
___Other

10. Was the material appropriate for your audience?

____Yes No, because_____

11. If you used the unit in a school, how much class time did you and your students spend on it?

____Less than 1 class ____2–3 classes ____1–2 weeks

____1 class ____4–5 classes ____More than 2 weeks

12. Do you regularly teach about global environmental issues?

____Yes ____No

13. If you don't regularly teach global environmental issues, did you find this unit offered enough information and materials to construct your lesson?

____Yes No, I also needed_____

14. Did you use other WRI materials with this unit?

____Yes ____No

If yes, which ones_____

15. Because new units of the *Teacher's Guide* are being developed, it is helpful for us to learn how the materials work. Did they engage your students? Prompt lively discussion? Help make what seemed abstract issues vivid? Please be specific with negative *or* positive comments.

_____

_____

_____

_____

Name_____

School or Organization_____

Address_____

_____

May we call you to discuss your suggestions?

____No Yes, I can be reached at_____

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